

## BRIEF REPORT

## Occult maternal exposure to environmental tobacco smoke exposure

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**Background:** Environmental tobacco smoke (ETS) is a recognised air pollutant. Its harmful effects have been found to be implicated in health disorders, including unfavourable pregnancy outcomes. The discrepancy between self-reported environmental tobacco smoke exposure and cotinine levels in pregnant non-smokers in France was examined.

**Method:** Plasma cotinine was determined by a CPG-SM method on women who had answered a self-questionnaire describing their habits and environment during pregnancy.

**Results:** Of 698 pregnant women reported as non-smokers, 305 (43.7%) claimed not to be exposed to ETS, yet 196 of these (64.3%) had plasma cotinine levels above the limit of detection.

**Conclusion:** Self-reported data on ETS exposure in pregnant women therefore underestimate actual exposure. However, cotinine assay can rectify this misclassification. An accurate identification of this risk factor will help to change attitudes towards ETS and avert its adverse effects on mother and fetus.

Although environmental tobacco smoke (ETS) has not yet been monitored in France, it is probably, as in the United States National Health and Nutrition Examination Survey (1999–2002), a major source of indoor air pollution. Low levels of ETS exposure can result in unfavourable pregnancy outcomes,<sup>1, 2</sup> and many pregnant women still believe that not smoking is sufficient to protect their fetus from ETS. Moreover, far less attention has been paid to perinatal ETS exposure. A better appraisal of these non-maternal sources and measurement of corresponding prenatal exposure will provide a useful basis for further work and discussion on its effects.

## METHODS

Our French multicentre study, approved by the ethics committee, conducted between July 2003 and June 2004 aimed to assess the accuracy of self-reported ETS exposure in pregnant non-smokers by comparison with plasma cotinine levels. Mothers and their newborns were recruited. A self-questionnaire (including the Fagerström test for nicotine dependence

**Table 1** Maternal characteristics and plasma cotinine levels (greater than the limit of detection) in each exposure group

	Non-exposed non-smokers	Exposed non-smokers	Smokers
Maternal characteristics (n)	325	419	211
Age, mean (SD)	31.02 (4.53*)	28.95 (4.81)	28.84 (5.19)
Occupational situation (%)			
Working	77.5	77.1	63.0**
Seeking work	4.9	6.9	6.2***
No occupation	2.2	2.6	0.9
Housewife	15.4	13.4	29.9
Occupational class in those working (%)			
Farmers	3.2	1.9	0.8
Craft trade and firm managers	4.5	5	9.1
Upper managerial staff and professionals	8.5	4.4	3.8**
Intermediary occupations	17.5	10.4	5.3**
Manual workers	2.9***	6.9	12.1
Clerks and trade-related employees	63.4*	71.4	68.9
Plasma cotinine levels (n)	305	393	211
n < LOD	109 (35.7%)	130 (33.1%)	4 (1.9%)
n (≥ LOD; 15 ng/ml)	194 (63.6%)	249 (63.4%)	35 (16.6%)
n > 15 ng/ml	2 (0.7%)	14 (3.6%)	172 (81.5%)
Median plasma cotinine levels (ng/ml)	1.1****	1.3****	58.0****
SD	2.2	20.7	81.5
Min (ng/ml)	0.46	0.46	0.55
Max (ng/ml)	20.4	239.1	390.4
Interquartile range (ng/ml)	0.6	1.0	114.5

LOD, limit of detection; max, maximum; min, minimum.

Limit of detection (LOD) = 0.46 ng/ml

\*p < 0.05 relative to exposed non-smokers and smokers.

\*\*p < 0.05 relative to exposed and non-exposed non-smokers.

\*\*\*p < 0.05 relative to exposed non-smokers.

\*\*\*\*p < 0.05 relative to each of the other groups.

**Abbreviations:** ETS, environment tobacco smoke; LOD, limit of detection

and one question on subjective assessment of ETS exposure ("living today in a smoking environment because of occupational exposure, family members and/or friends") designated smokers, exposed non-smokers or non-exposed non-smokers. Cotinine levels were also analysed (gas chromatography/SM analysis method) from maternal plasma at delivery. Data analysis was performed using the SAS statistical software package (statistical tests used a two-sided risk  $\alpha$  of 5%;  $\chi^2$  tests were used for categorical variables (Occupational situation, Occupational class in those working) or Student *t* tests for continuous variables (Age, plasma cotinine levels); median values, standard deviations and interquartile range for plasma cotinine levels).

## RESULTS

Of the 1114 women who had given birth in all the maternity wards surveyed during the study period, 955 met the inclusion criteria, agreed to participate, and reported their ETS exposition and tobacco status. Exposed non-smokers were significantly older than non-smokers and more numerous in manual workers and in women seeking work, as shown in table 1.

The median plasma cotinine level (table 1) was 46 times higher among smoking mothers than among exposed non-smoking mothers ( $p < 0.001$ ) and 1.2 times higher among exposed non-smoking mothers than among non-exposed non-smoking mothers ( $p < 0.05$ ). The range of cotinine values in each class (smokers, non-exposed, exposed) was very broad, especially for the exposed non-smoking mothers, in whom the highest value was almost 520 times higher than the limit of detection. More surprisingly, a large majority (64.3%) of mothers had detectable levels of plasma cotinine even though they claimed not to be ETS-exposed. Two such mothers even had the same cotinine levels as smokers.

## DISCUSSION

Cotinine levels showed that more than one in two pregnant women was unaware of being exposed to ETS. Moreover, although the exact level of cotinine taken to reflect ETS exposure is not clearly established, the cut-off of the limit of detection (0.46 ng/ml) taken in this study is higher than the literature consensus value. This indicates that ETS is demonstrated at or above 0.05 ng/ml,<sup>2-5</sup> suggesting that the extent of unawareness may well be higher. It confirms that studies based on an ETS question for pregnant women are likely to

misclassify a sizeable portion of ETS-exposed women as "unexposed" even if we explore present exposure. Mothers were not conscious of ETS, in so far as they were not routinely exposed to ETS.<sup>6</sup>

Our results argue for an objective measure of ETS exposure rather than a subjective one even though asking questions on the smoking environment is at least a step in the right direction in clinical practice. Identifying and reducing smoke exposure among pregnant women deserves closer attention in healthcare programmes.

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